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Preliminary Estimates of Harp Seal By-catch In the Newfoundland Lumpfish Fishery

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Abstract

The incidental by-catch of marine mammal species in fishing gear is a worldwide phenomenon of major conservation concern. Although the waters of Newfoundland have been intensively fished and the by-catch of marine mammals may be substantial, little effort has gone into quantifying the magnitude of the take. What information is available focuses primarily on entrapments of large cetaceans while small cetaceans and seals are under-reported or not reported at all. This research document presents preliminary estimates of the number of harp seals taken as by-catch in the Newfoundland lumpfish gill net fishery from 1970 – 1998. Estimates of fishing effort (the amount of roe landed) and the number of seals taken annually were obtained from a By-Catch Logbook Program conducted by fishermen from 1989 – 1998 in Newfoundland waters. Prior to 1989, annual seal by-catches were estimated using historic roe landings and average by-catch levels based on the Logbook Program. From the start of the commercial fishery in 1968 until 1984 the by-catch of harp seals remained below 10,000 animals. During the next three years it increased dramatically to a high of approximately 30,000 seals in 1987 and then dropped sharply to just below 3,000 by 1990. It then increased again to a high of approximately 36,000 seals in 1994 and then dropped to 17,000 in 1995 where it has remained. These estimates of the number of harp seals taken during the lumpfish gill net fishery provide a long term view of by-catch as a source of mortality for harp seals and also provide the basis for future by-catch work and population modeling initiatives.

Résumé

Les prises accidentelles de mammifères marins par des engins de pêche constituent un phénomène mondial très préoccupant sur le plan de la conservation. Bien qu'on ait intensément pêché dans les eaux de Terre-Neuve et que les prises accidentelles de mammifères y sont peut-être importantes, peu d'efforts ont été déployés pour déterminer l'ampleur de ces captures. Le peu d'information disponible porte surtout sur les captures accidentelles de grands cétacés dans des engins de pêche. Cependant, les prises accidentelles de petits cétacés et de phoques sont sous-déclarées ou pas signalées du tout. Ce document de recherche présente des estimations préliminaires du nombre de prises accidentelles de phoques du Groenland dans la pêche terre-neuvienne de la lompe au filet maillant, de 1970 à 1998. Des estimations de l'effort de pêche (quantité d'œufs de lompe débarqués) et le nombre de phoques capturés annuellement ont été obtenus du Programme de registres de bord des prises accidentelles réalisé par les pêcheurs de 1989 à 1998, dans les eaux terre-neuviennes. Avant 1989, les prises accidentelles annuelles de phoques étaient estimées à partir des débarquements historiques d'œufs de lompe et des prises accidentelles moyennes relevées dans le cadre du Programme de registres de bord. Du début de cette pêche commerciale en 1968 jusqu'à 1984, les prises accidentelles de phoques étaient demeurées inférieures à 10 000 animaux. Pendant les trois années suivantes, elles ont grimpé pour atteindre un maximum d'environ 30 000 phoques en 1987, puis elles ont brusquement chuté à un peu moins de 3 000 en 1990. En 1994, elles ont augmenté de nouveau, jusqu'à environ 36 000 phoques, puis elles ont baissé à 17 000 en 1995 et, depuis, elles se sont stabilisées à ce niveau. Ces estimations du nombre de phoques du Groenland capturés dans la pêche de la lompe au filet maillant donnent une perspective à long terme sur les prises accidentelles en tant que cause de mortalité de ces phoques et servent de point de départ pour les travaux futurs dans ce domaine, notamment pour les initiatives de modélisation de la population.

Introduction

Marine mammal by-catch in fishing gear has been a serious conservation problem since humans began to harvest the resources of world's oceans for food on a large commercial scale. By-catch is defined as the incidental entrapment of non-target species in fishing gear; it often occurs when several species utilize the same resources (Murawski, 1995). Perhaps the most publicized examples of marine mammal by-catch have been the high number of dolphins killed in purse seine nets set to catch tuna (Harwood, 1983). In 1972, the International Whaling Commission (IWC) formally expressed concern over this large incidental take of dolphins which then prompted a review of by-catch levels occurring in other fisheries (Perrin et al., 1994). It soon became apparent that many different species of marine mammals were killed accidentally in various fisheries around the world.

Despite the growing concerns about the potential negative impacts of marine mammal by-catch at the population level, relatively little effort has gone into quantifying catches (Harwood, 1983; Lien et al., 1988; Woodley & Lavigne, 1991). Until recently, by-catch information tended to be collected opportunistically and focused on a limited number of larger cetacean species and/or endangered cetacean species. In general, by-catches of many small cetaceans species and seals have been under-reported because of fisherman's attitudes and cultural traditions (Fontaine et al., 1994; Hall-Arber, 1995). Small cetaceans and seals are often viewed as nuisances because they damage fishing gear and are perceived to be competing with fishermen for fish. When these species are taken as by-catch they are less likely to be reported because damage to fishing gear is minor compared to that caused by large cetaceans, fishermen generally do not require assistance in removing the smaller species from their nets, and in some cases the by-catch species may be consumed as food (Lien et al. 1988).

Of the six seal species found in Newfoundland and Labrador waters (harp, hooded, grey, harbour, ringed and bearded seals) all are known to occur as by-catch in various types of fishing gear including trawls, purse seines, gill nets, and hook and lines (Woodley and Lavigne 1991; FAO 1995). The limited information available on by-catch in Newfoundland is based on fishermen's comments obtained through phone interviews, in situ interviews, logbook programs, and written questionnaires (Lien et al. 1988; Lien et al. 1994; Piatt and Nettleship 1987; Sjare and Stenson unpublished data). In most regions of the Province it appears that harp seals are the most common by-catch species and they are taken primarily by inshore monofilament gill nets set for cod, flounder and lumpfish. The magnitude of the seal by-catch in Newfoundland and Labrador waters is essentially unknown but could be substantial (Lien et al. 1988; Lien et al. 1994; Piatt and Nettleship 1987). Entrapped seals are usually dumped at sea or used locally for food, hence these incidents go unreported (Lien et al., 1988).

The problem of seal by-catch in the Newfoundland lumpfish fishery is not a new issue. The commercial fishery began in 1968 and was conducted by inshore fishermen between April and July, using small vessels less than 35 feet long (Blackwood, 1983). Initially, the fishery began along the northeast coast of Newfoundland but quickly spread to the south coast. Since 1977, the Department of Fisheries and Oceans has been promoting the lumpfish fishery and developing it in areas where it previously did not exist (Blackwoood, 1983). By 1985 fishermen were reporting increasing numbers of young harp seals in their lumpfish nets and significant damage to fishing gear (Barker 1985; Rompkey 1985). The downturn in many of Newfoundland's fisheries in the early 1990s resulted in reduced quotas for many species and the moratorium on Atlantic cod stocks from 1992 to the late 1990s. During this period there were strong initiatives to fish previously under-utilized species in the absence of many groundfish species which resulted in seal mortalities in the lumpfish gill net fishery off Newfoundland. A preliminary study of the seal by-catch in the Newfoundland lumpfish fishery indicated that from 1989 to 1993 the numbers of seals taken annually varied between 6,000 and 20,000 which was higher than previously thought (Sjare and Stenson, unpub. data).

Lumpfish are short, stout fish distributed on both sides of the North Atlantic with major concentrations found on the St. Pierre bank off the southeast coast of Newfoundland (Gavaris, 1985). They remain in deep offshore waters from late September to April and then migrate inshore during late April or early May to spawn (Stevenson and Baird, 1988). The fishery concentrates on spawning females for the roe market - males and immature female fish are discarded. Lumpfish fishermen typically use between 20 and 100 large (8 –10 inch) mesh nets that are set in a series of long strings. Generally nets are left to fish for 2 to 3 days before they are hauled; however, they may remain longer due to bad weather.

The timing of fishing activity and the type of gear are the key factors influencing the level of seal by-catch. Young harp seals born in March migrate out of the southern Gulf of St. Lawrence in April and May. Those born off the northeast coast of Newfoundland disperse and move northward. Adult harp seals leave the spring moulting concentrations in the Gulf of St. Lawrence and off the northeast coast of Newfoundland during May and June and migrate northward into Arctic waters to feed for the summer and early fall (Lavigne and Kovacs, 1988; Sergeant 1991). During this spring migration harp seals of all age classes may travel along inshore areas of Newfoundland and it is these animals (particularly young seals) that encounter lumpfish gillnets.

This manuscript provides preliminary estimates of the number of harp seals taken as by-catch in the Newfoundland lumpfish fishery from 1970 – 1998. Given that during the years of the northern cod moratorium the lumpfish fishery was probably responsible for the greatest proportion of seal by-catch taken by the

fishing industry, these data provide an opportunity to evaluate an important source of unreported harp seal mortality through modeling initiatives.

Methods

From 1989 – 1998 fishermen throughout Newfoundland participated in a voluntary By-Catch Monitoring Program initiated by the Department of Fisheries and Oceans. Although some information was obtained on most nearshore gillnet fisheries, the Program focused on the lumpfish industry. The number of fishermen involved in the Program has varied from 4 to 26 and there was an attempt to select participants in certain areas to ensure the best geographic coverage possible. Names of potential participants were solicited from a variety of sources and then individuals were contacted to see if they were interested in participating in the Program. Each fisherman was requested to record the weight of roe landed and the number, relative age and species of seals caught on a daily basis. Additional information on fishing effort, fishing location, weather conditions and size of crew and boat were also collected.

Historical and recent roe landings for Newfoundland from 1970 – 1998 were obtained from DFO Statistics Branch, St. John's. Although the commercial lumpfish fishery started in 1968, there are no records of any landings. Information from 1970 – 1975 is considered to be complete but cannot be cross validated with other data sources such as purchase slips or hale reports. A detailed breakdown of landings for some NAFO unit areas along the west coast of Newfoundland are not currently available for the period 1986 –1992 due to changes in jurisdiction between Newfoundland Region and Gulf Region. Only inshore landings taken by boats 35 ft. and under were considered.

To obtain regional information that reflected the nature of the current lumpfish fishing industry and the natural marine ecological regions within the Province, fishermen were assigned to one of the following areas: Northeast Coast (NAFO division 3K and 3L), South Coast (3Ps and 3Pn), or West Coast (4R; Fig. 1). For the purposes of this manuscript NAFO unit areas 3Lq and 4Rd were considered part of the South Coast because the intensity of fishing operations and the high seal by-catch levels were more consistent with that area. Information from individual fisherman on the number of seals caught and the weight of roe (kg or tonnes) landed during the season were pooled by marine region. Estimates of harp seal by-catch rates were then expressed as the number of seals caught/tonne of roe landed. The total number of seals caught in lumpfish gill nets in each region on an annual basis was estimated using the ratio of the number of seals caught/tonne of roe and then extrapolating to the total weight (tonnes) of roe taken in that region.

A large proportion of the seal by-catch in lumpfish gill nets was young harp seals; however, other species including harbour seals and grey seals were also caught. In some cases the fishermen were able to reliably identify the various seal

species, but in many cases 'unknown seal' was noted in the logbook. The information presented in this manuscript includes only harp seals. To estimate how many of the 'unknown seals' taken in a region were this particular species, the proportion of identified harps seals in the region was applied. A similar approach was used to estimate what proportion of the by-catch in a region was young harp seals born that year (i.e. a beater) compared to a seal that was greater than one year of age. If there was insufficient data on the number of young seals taken within the regions, information was summed across all regions for that particular year and applied to all areas.

For the years prior to the By-catch Monitoring Program (1970 -1988) the number of seals/tonne of landed roe in each region was assumed to be the median value for the period 1989 – 1998. The proportion of beaters in the catch for each region was assumed to be the average for the period 1989 –1998.

Results

The commercial lumpfish roe fishery developed slowly for the first 15 years with landings increasing to approximately 500 tonnes by 1984. During the next 3 years there was a dramatic increase with roe peaking at 3,000 tonnes in 1987. In more recent years roe landings have varied between 1,000 – 2,300 tonnes (Fig. 2). Roe landing from the South Coast made up the greatest proportion of the total catch in the early 1980s and then again after 1992. Table 1 summarizes the percentage of landed roe that was monitored for seal by-catch in each region of Newfoundland by fishermen; the North East Coast had the lowest coverage with a range of 0.2 - 1.4% while the South Coast had the highest 2.5 - 8.9% coverage.

The number of seals caught/tonne of roe by fishermen in each region on an annual basis was highly variable (Table 2). For the Northeast and South Coasts values ranged from 1.54 - 30.33 seals/tonne and for the West Coast they ranged from 0 – 276.69 seals/tonne. The median values for the Northeast, South and West Coasts for the years 1989 – 1998 were 10.66, 5.73 and 13.23 seals/ tonne of roe respectively. Estimates of total seal by-catch in Newfoundland derived from these median values were incorporated into the current run of the population model. Estimates of total seal numbers based on a 5-year and 3-year median are tabulated for comparative purposes.

The proportion of beaters in the by-catch showed considerable variation on an annual basis as well as between region differences (Table 3). The South Coast by-catch had the highest proportion of beaters (range 0.24 – 0.97; mean = 0.83) and the Northeast Coast the lowest (range 0.16 – 0.88; mean = 0.56). The average values were assumed for the historic data set.

Estimates of the total number of harp seals taken as by-catch in Newfoundland during the lumpfish fishery are shown in Figure 2. Estimates remained below 10,000 seals until 1985 and then increased dramatically to a high of approximately 30,000 in

1987. By 1990 the by-catch had dropped to below 3,000, then peaked at a high of approximately 36,000 seals in 1994 and has remained at approximately 20,000 since that time. Estimates of the total number of seals taken as by-catch in each region are shown in Figure 3. Seals taken along the Northeast Coast in 1987 and 1988 comprised the major portion of the very high by-catch in those years while the seals take along the South Coast contributed significantly to high take in 1994.

Discussion

The database resulting from the By-Catch Monitoring Program is the most complete time series of information on marine mammal by-catches in Newfoundland waters. These preliminary estimates of the number of harp seals taken in the lumpfish gill net fishery are the first attempt at providing a long-term view of by-catch as a source of mortality for this species. However, there are a number of data gaps and assumptions that strongly influence the reliability of the estimates and will have to be addressed in the future.

One of the greatest difficulties in attempting to estimate the number of harp seals taken in the lumpfish fishery stems from the fact that there is no information on fishing effort for the industry. Therefore, roe landings were used as an index of fishing effort in this study. The appropriateness of this index is requires further examination, however, if roe landings and fishing effort are strongly linked this would explain the high seal by-catch in some years. A more direct index would be one based on net days where the fisherman records the number of nets fishing and the soak times. This information is available for the years of the By-catch Program and will be used to compare roe landings, seal catches and fishing effort in the near future. A preliminary analysis of these data for fisherman in the Program from 1989 to 1993 suggested that the increasing number of seals taken were primarily the result of increased fishing effort (Sjare and Stenson unpublished data).

The limited number of fishermen involved in the By-Catch Program is problematic given the amount of coastline that requires monitoring. The highly variable estimates of the number of seals taken/tonne by fishermen within and among regions on an annual basis are likely due to this sampling problem. Future research will place considerable effort on evaluating whether the extrapolation techniques used here are appropriate and on determining the best method to estimate variance associated with the number of seals caught/tonne of roe. Given this problem, using these highly variable seal catch rates obtained from fisherman during the By-catch Program to estimate the annual take of seals prior to 1989 is tenuous. However, when seal catch estimates are refined and more is known about the relationship between roe landings and seal catch rates it will be possible to address some of the hindcasting problems in more detail.

In some cases it may be possible to clarify observations from the logbook data base and address knowledge gaps for years prior to 1989 by conducting additional interviews (particularly with fishermen who participated in the program for several years). More detailed information on the species and relative age composition of the by-catch may be obtained for recent years if fishermen are given good quality photographs of the various seals to look at and compare. In many cases they don't recall the name of a particular species but can easily recognise it. Most fishermen along the Northeast and West Coast can reliably identify seals, however; this is not the case for fishermen along the South Coast. Information on long-term species or age composition changes in the by-catch may be obtained from some of the fishermen who have a family history in the lumpfish industry. These individuals may also be able to provide general comparisons between the number of seals taken as by-catch in the 1990s, early 1980s, and 1970s. This would be helpful in evaluating the validity of the assumed by-catch levels used in this study.

Most fishermen base their lumpfish operations out of a small boat (<35 ft); however, since the 1980s approximately 10 – 20% of roe landings have been from longliners. This study addresses seal by-catch from small boat fishermen only. It would important to determine how similar by-catch levels are between the two vessel types. Given that longliners must also fish in shallow coastal waters it is possible there may not be large differences. However, the relationship between the scale of a fishing operation and by-catch level requires further attention; longliners likely put out significantly more gear in a larger area.

And finally, a general knowledge of weather and ice conditions during peak fishing periods (at least for recent years) will be helpful in explaining some of the variability associated with roe landings and seal by-catch estimates. The roe landings and estimates of seal by-catch in this preliminary study are not adjusted for the effects of storms and bad ice conditions. Based on the comments made by fishermen in their logbooks bad weather and heavy ice blown inshore influences how often they haul their nets; the longer the fishing time the greater the chance the roe will deteriorate and have to be discarded. This could cause the estimate of seal caught/tonne of roe to increase since the nets are in the water longer potentially entangling seals for the whole period yet the fisherman only recorded the weight of the roe he kept (which underestimates what his actual catch was). However, the logbooks also indicate that the seriousness of this potential bias may depend on the experience of individual fishermen, where they fish, and the oceanographic conditions at the time.

The results presented here on harp seal by-catch are difficult to compare directly with published information because of different methodologies and research scope (most published accounts are limited from a geographical and/or temporal perspective). However, in most cases they are generally supportive, if not consistent, with the finding in this manuscript.

Piatt and Nettleship (1987) recorded incidental takes of marine mammals for the south and east coast of Newfoundland during the summers of 1981 to 1984. Reports were based on direct observations by the authors as well as documented information from fishermen that listed numbers of species caught along with the type of areas and depths fished. An estimated 746 harp seals were taken annually in relatively deep-set cod and flounder gill nets set up to 100 km from shore in the vicinity of three major sea bird colonies. Most harp seals were taken in May and June and 91% of the catches consisted of immature harps (2-3 years old).

A minimum of 10,700 harp seals were taken along the west coast of Newfoundland (between St. Anthony and Port Aux Basque) in gill nets during the spring of 1988 (Lien et al. 1988). This data was derived from a monitoring program conducted by the Department of Fisheries and Oceans and Memorial University of Newfoundland between 1978-1988. Most information came from interviews with fishery officers and fishermen who reported that grey, harbour, harp and hooded seals are caught incidentally, mainly in monofilament gill nets set for cod and lumpfish. The majority of entrapments involve young harp seals that were caught in May and June along the West and South Coasts of Newfoundland during the northward migration to summer feeding areas in Arctic waters (Lien et al., 1988). Based on comments and complaints from fishermen participating in the Whale Entrapment Program in the Bonne Bay area, Lien et al. (1987) estimated that 8 – 15 young harp seals were caught per 60-70 nets per day.

In summary, the results of the By-catch Monitoring Program are consistent with many fishermen's views, the general perceptions of Lien et al. (1988) as well as the author's current view on the by-catch (pers. comm. 1999). Perhaps more importantly this new information provides a framework to better interpret previous studies as well as provide the basis for future by-catch research, population modeling initiatives and the development of sustainable management plans.

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Table 1: Percentage of the total amount of landed roe monitored for seal by-catch in each region of Newfoundland from 1989 – 1998.

Year	NE Coast	South Coast	West Coast
1989	0.2	4.8	1.2
1990	0.4	5.1	1.3
1991	1.0	6.1	1.3
1992	1.3	8.9	1.9
1993	1.0	4.8	3.7
1994	0.8	3.9	7.1
1995	0.3	2.6	0
1996	1.4	2.5	1.8
1997	0.6	3.4	0.5
1998	0.5	4.0	1.2

Table 2 : Estimates of the total number of seals taken as by-catch/tonne of landed roe along the Northeast, South and West Coasts of Newfoundland from 1989 – 1998.

Year	NE Coast	South Coast	West Coast
1989	4.21	0	3.93
1990	1.54	1.64	7.79
1991	2.61	6.92	1.23
1992	7.97	7.34	18.59
1993	13.34	3.53	132.44
1994	17.04	23.13	276.69
1995	37.3	10.85	0
1996	30.33	9.21	24.97
1997	21.92	4.54	7.87
1998	4.52	1.64	43.01
Median	10.65	5.73	13.23
Median 5 yr	4.21	3.53	7.79
Median 3 yr	2.61	1.64	3.93

Table 3: Estimates of the proportion of young harp seals (beaters) taken as by-catch from each region of Newfoundland from 1989 – 1997 (data were not available for 1998).

Year	NE Coast	South Coast	West Coast
1989	0.88	0.90	0.90
1990	0.60	0.93	0.93
1991	0.72	0.97	0.97
1992	0.64	0.82	0.53
1993	0.72	0.94	0.98
1994	0.50	0.83	0.85
1995	0.38	0.24	0.31
1996	0.16	0.90	0.05
1997	0.47	0.92	0.59
Mean	0.56	0.83	0.68
SD	0.21	0.23	0.33

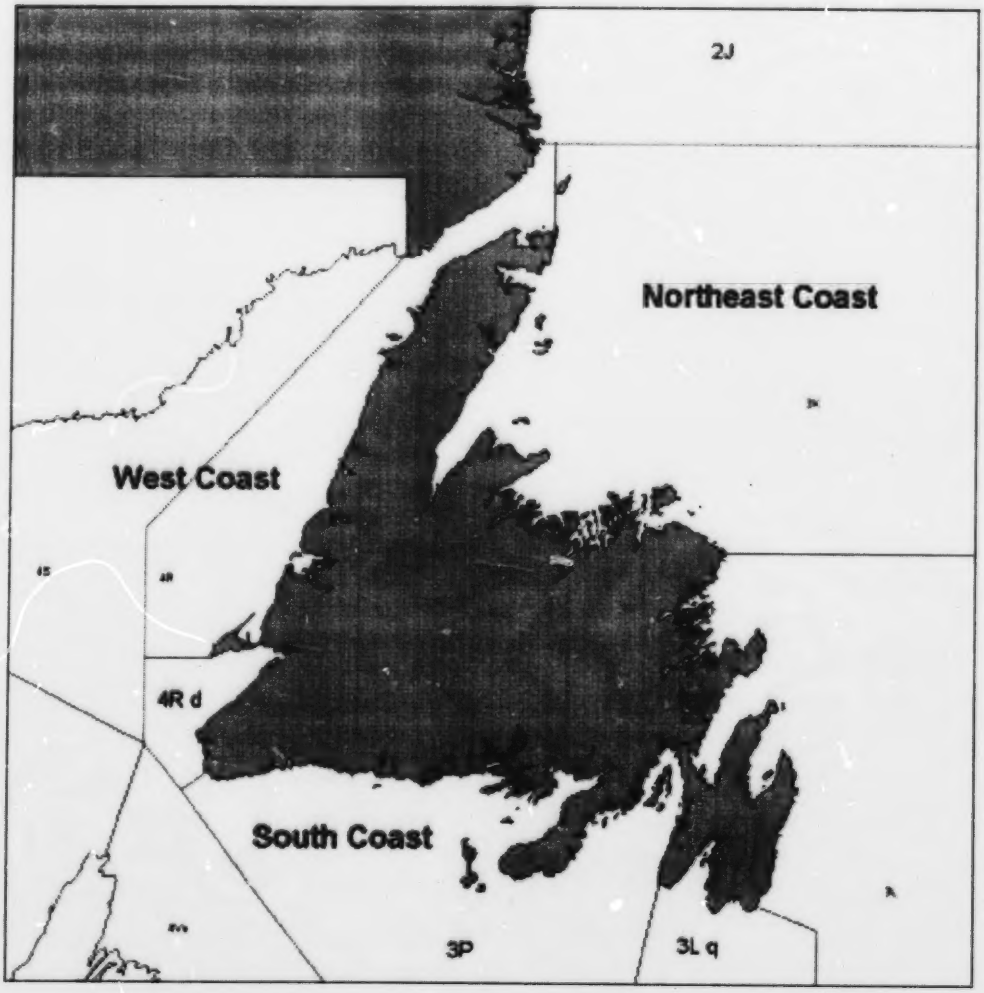

Figure 1: Map of Newfoundland coastal regions

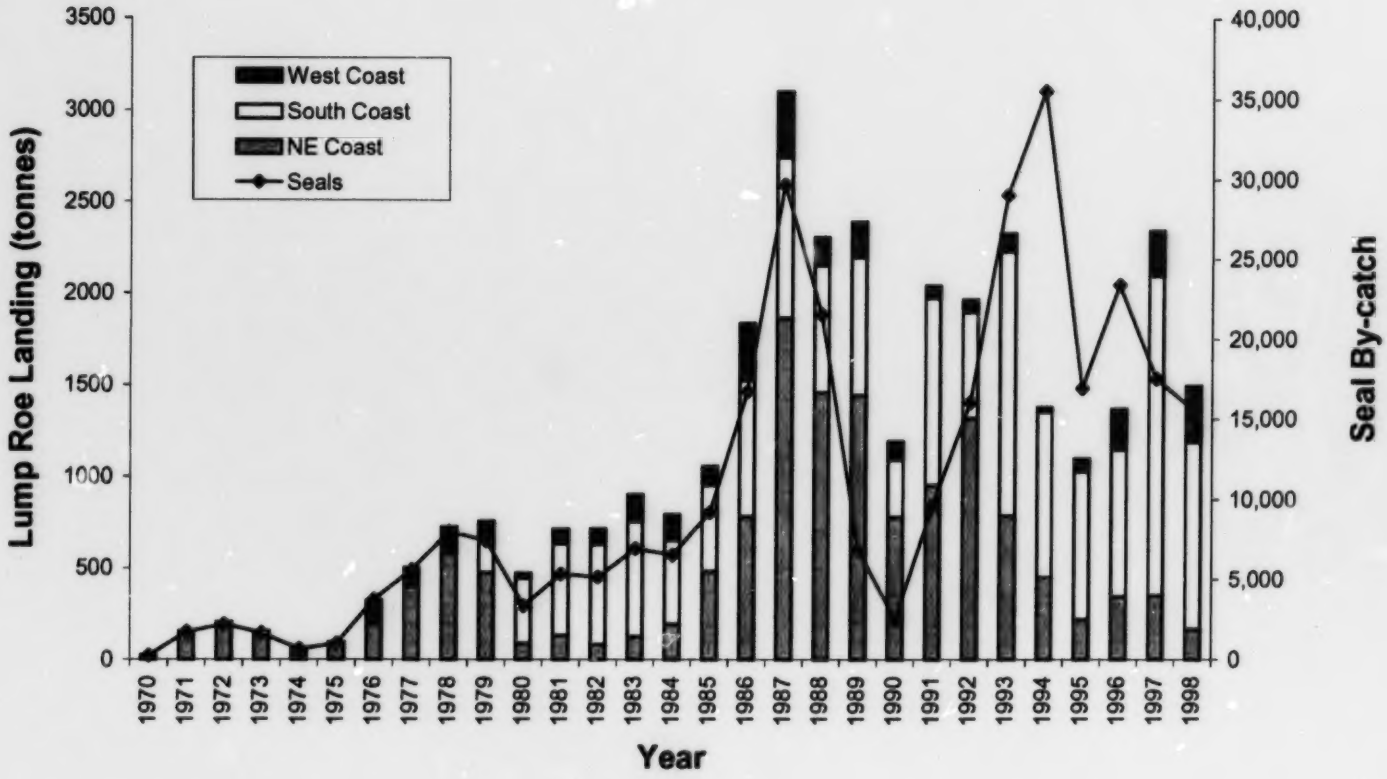

Figure 2: Lumpfish roe landings and estimated seal by-catch in Newfoundland 1970 - 1998.

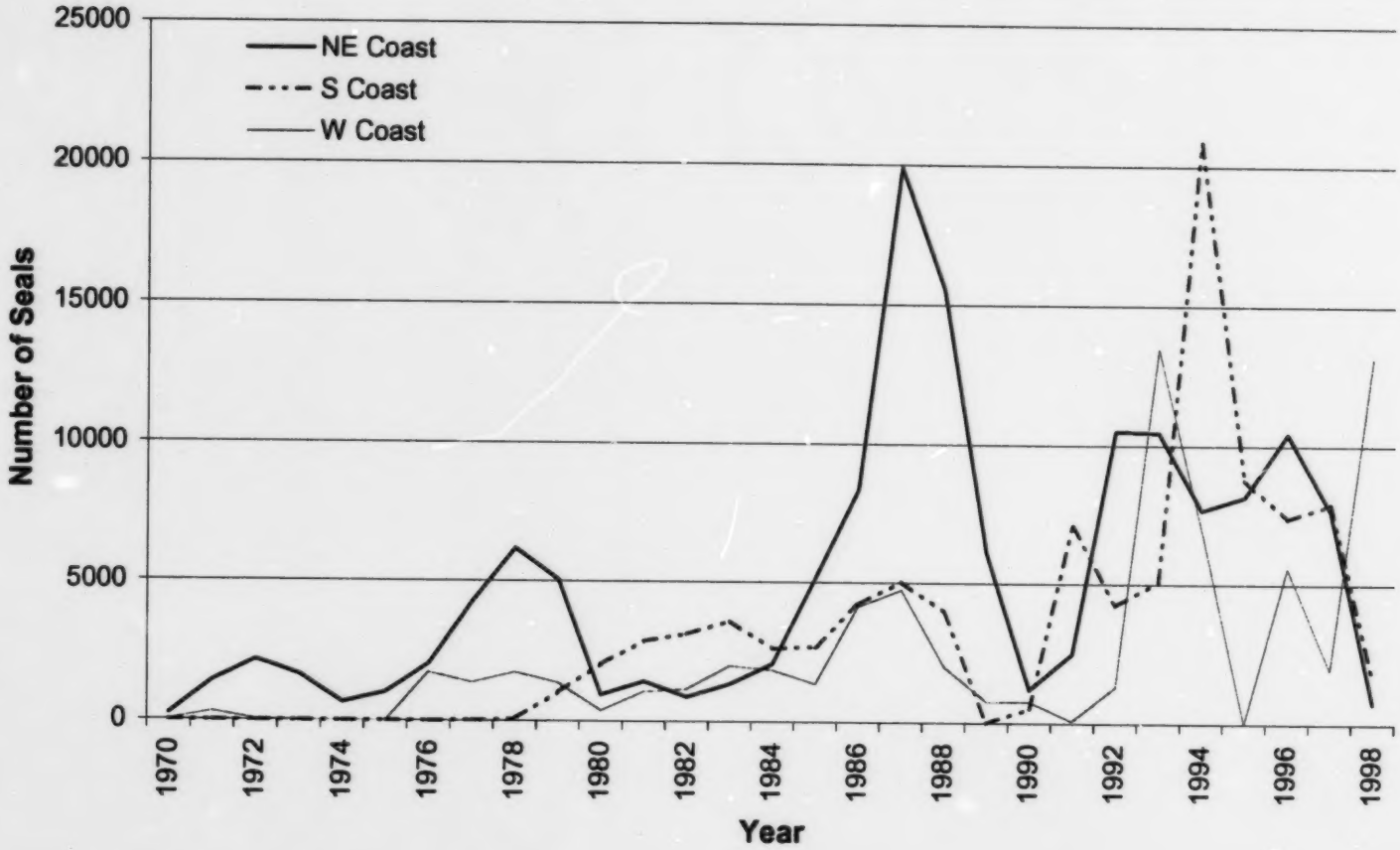

Figure 3: Estimated harp seal by-catch along the northeast, south, and west coasts of Newfoundland.